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WOODEN AND FIBER BOXES.

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INTRODUCTION.

Nearly all shipping boxes are either of wood or of fiber. Lumber as it comes from the sawmill or planing mill is the material from which the wooden box is made, while the fiber box is made of pulp, composed of two or more fibrous materials and pressed into boards of suitable thickness and strength. Though for certain uses each kind is fairly secure in its own field, in some lines the two come into keen competition. The manufacturers of wooden boxes have been of the opinion that during the past few years the growing use of fiber containers has resulted in decreasing the demand for wooden boxes to the extent of from 30 to 40 per cent, and have held that the inroads made by this new shipping container were bringing about a demoralized condition of the wooden-box business. Lumber manufacturers have shared in this opinion to a large extent, and to the assumed situation ascribed in part the present lack of demand for low-grade lumber. On the other hand, the makers of fiber boxes questioned the correctness of these figures, and have insisted that the displacement would not exceed 5 per cent. The relative merits of the two kinds of boxes have also been in controversy. Moreover, there has been disagreement as to which kind best utilized material from forest and mill, which otherwise would be wasted. The purpose of the investigation upon which this circular is based was to determine to what extent the fiber box has replaced the wooden one, and how far the development of the fiber-box industry is likely to go, and what effect, if any, the growing use of fiber boxes will have in bringing about the fullest utilization of forest-grown material.

THE WOODEN BOX.

Until recent years the demand for wooden boxes, though widespread, was comparatively small. It grew enormously with the building of railroads and the increase of trade. At first lumber was so plentiful and cheap that box manufacturers, like nearly all other classes of wood users, demanded high grades and ignored inferior stuff. Waste in the woods and at the mill was given little considera-

tion. Shoe boxes in New England were made of white pine of a grade which pattern makers and sash factories would now be glad to get, and soap factories insisted on a grade of yellow poplar good enough for carriage panels and car finish. Clear sycamore, even quarter sawed, was demanded for plug-tobacco boxes, and starch was shipped in boxes of basswood clear enough and soft enough to meet the demands of pyrography.

That situation, however, could not last always. The constantly lessening forest area and the ever-increasing demand for lumber raised the cost of the grades which the box maker had formerly demanded, and he was forced to take lower grades and other kinds of wood. As boxes came into wider use, his demands increased, and year by year circumstances forced lower and cheaper grades of lumber upon him. The box factory became the market for what the sawmill had left after it had supplied its other customers. Such is the situation to-day. Billions of feet of lumber yearly go to the box maker as a last resort. He can use it, but the furniture factory, and boat builder, and musical-instrument maker can not. If it is not used for the boxes, it will be left in the woods or at the mills to rot. Where formerly few kinds of wood were accepted by the box manufacturer, he now takes nearly every kind. This can not be better illustrated than by presenting a list of woods and the amount of each bought by the box factories in the State of Illinois in 1910.

Box lumber used in Illinois, 1910.

Species.	Quantity.	Species.	Quantity.
	Board feet.		*Board feet.*
White pine (*Pinus strobus*)	105,438,000	Balm of Gilead (*Populus balsamifera*)	2,475,000
Red gum (*Liquidambar styraciflua*)	50,774,000	White ash (*Fraxinus americana*)	1,200,000
Cottonwood (*Populus deltoides*)	38,807,000	Cypress (*Taxodium distichum*)	910,000
Hemlock (*Tsuga canadensis*)	34,477,000	Red cedar (*Juniperus virginiana*)	875,000
Sweet birch (*Betula lenta*)	20,146,000	Black ash (*Fraxinus nigra*)	635,000
Paper birch (*Betula papyrifera*)	19,312,000	Sycamore (*Platanus occidentalis*)	400,000
Silver maple (*Acer saccharinum*)	15,234,000	Black spruce (*Picea mariana*)	363,000
Short-leaf pine (*Pinus echinata*)	13,740,000	Red oak (*Quercus rubra*)	250,000
Long-leaf pine (*Pinus palustris*)	13,405,000	Chestnut (*Castanea dentata*)	200,000
Sugar maple (*Acer saccharum*)	12,565,000	Red pine (*Pinus resinosa*)	150,000
Basswood (*Tilia americana*)	12,212,000	Northern white cedar (*Thuja occidentalis*)	100,000
Yellow poplar (*Liriodendon tulipifera*)	10,821,000	Tamarack (*Larix laricina*)	75,000
White elm (*Ulmus americana*)	6,124,000	Loblolly pine (*Pinus taeda*)	64,000
Slippery elm (*Ulmus pubescens*)	5,000,000	Black willow (*Salix nigra*)	30,000
Beech (*Fagus atropunicca*)	3,493,000		
Tupelo (*Nyassa aquatica*)	2,750,000	Total	372,025,000

THE FIBER BOX.

It is not improbable that the fiber box is as old as the box of wood; history does not record the first use of either. While the ancient Egyptians, with rude gimlets, rubbing stones, and clumsy tools of other kinds, were making coffins of hewed logs or joined boards and staves of Lebanon cedar and sycamore, they were also making coffins

of woven and intertwined reeds, grasses, and leaves. Both were crude prototypes of the modern box. The container made of fiber, first reduced to pulp, dates from the invention of paper. A century or two ago the most common and principal form was the old-fashioned bandbox. This was generally pasteboard, made largely of straw or some material other than wood pulp.

Fiber boxes of that kind entered little or not at all into competition with wooden boxes. Each had its field, and the two kinds continued until a few years ago to go their respective ways without any business rivalry. But as industries developed which demanded a light shipping container fiber boxes grew enormously in usefulness. The old country store sold sugar and tied it up in brown paper; sold starch, soap, shoes, tacks, sulphur, coffee, nails, and foods in the same way, and the clumsy packages were received by the purchaser without protest because nothing better was known. But the manufacturers whose commodities were to be sold in parcels learned that an attractive, convenient container was half the sale, and the fiber carton, or small box, came into use for coffee, tacks, sugar, starch, shoes, collars, and thousands of commodities which formerly had gone to the retailer in bulk. The sudden increase in the manufacture of thread on spools that came with the invention of the sewing machine, and the rapid growth of the custom-made shoe industry, led to a great demand for fiber boxes. Later followed a much greater demand, when foodstuffs, such as cereals, dried fruits, and confectionery, sought markets in cartons neatly sealed and handsomely lithographed. However, up to that time the fiber box was not a competitor with the larger and stronger box made of lumber. The fiber cartons were shipped in wooden cases and boxes, thereby increasing rather than diminishing the demand for such. But the constantly increasing demand for the two kinds of boxes was soon to bring about competition. This was hastened, too, by the constantly increasing cost of the lumber which went into the wooden box, and by the discovery that the fiber box could be made strong enough to take the place of the wooden one, and at less cost than the other.

SPECIFICATIONS FOR FIBER BOXES.

Boxes which carry merchandise from the producer to the consumer must possess sufficient strength to stand the rough usage incident to shipment by railroad, boat, wagon, and occasionally by horseback over mountain trails. The size of fiber boxes, the thickness of the board of which they are made, the maximum weight of each box when filled for shipment, and the minimum strength of the board, are governed by rules which railroads and other common carriers rigidly enforce. Railroads accept for shipment by freight any commodity packed in fiber boxes that they will accept if packed in

wood, provided these regulation sizes and weights are not exceeded. No such regulations, however, are insisted upon for wooden boxes. Three thicknesses of fiber board are specified, 60, 80, and 100 points; that is, 60, 80, and 100 thousandths of an inch in thickness, respectively. As there are three recognized thicknesses for the board, there are three sizes of boxes, and the size is designated by adding the three dimensions, length, breadth, and depth. The 60-point board must not be made into boxes whose three dimensions exceed 65 inches, or whose weight when filled for shipment exceeds 40 pounds. The 80-point board is for a box whose three dimensions do not exceed 70 inches, and the 100-point board for one of 75 inches, and a maximum weight when filled for shipment of 90 pounds. Boxes not up to the standard for strength are not accepted by railroads for shipment. Larger fiber boxes or containers are occasionally accepted by express companies that do not insist on the foregoing enforcement of the regulations. Railroads accept fiber boxes of a shipping weight up to 200 pounds, if the corners are properly reenforced with wood or metal.

COMPOSITION OF FIBER BOARD.

In dealing with fiber board a distinction is sometimes made between straw board, jute board, chip board, and pulp board. This distinction, however, is not essential to the present discussion. Fiber board, as the term is here meant to be understood, is made principally of one or more of four materials. Of the total materials reported in the course of the investigation, 57 per cent was chip, 22 per cent straw, 16 per cent wood pulp, and 5 per cent jute. Chip consists of old papers, low grade or refuse material from pulp mills, screenings, and waste of other kinds repulped and used again. The straw is the ordinary farm product. The jute consists of old rope and bagging. The wood pulp comes directly from the forest and is not old material repulped. Part of it is low grade and has short fiber. It is mixed with other cheap pulp, but in order that the board may have the required strength a small quantity of long-fibered wood pulp must be added to the mixture. Much of the best grades used for that purpose is imported from Norway and Sweden. Until recently no mills in this country manufactured that kind of pulp, but some are now being equipped to do so.

It thus appears that except for the small quantity of good wood pulp fiber board is made almost wholly of waste material. At least half of it is old newspapers, screenings, wrapping paper, paper boxes, and such material. But rope and bagging are no less products of the waste heap. The increased price paid for old papers since fiber-board boxes stimulated the demand has resulted in drawing supplies from small towns and rural communities, where formerly no one went to the trouble of collecting such material. It has encouraged also the diligence of scavengers who search the alleys, ash cans, and public

garbage dumps in cities. It is a fact brought out by this investigation that New Orleans is shipping the contents of its waste baskets to Chicago for the fiber-board industry. The same material is pulped again and again; the old papers become boxes, are filled with merchandise, go to the towns, are thrown into the waste barrel, and are collected and sent back to the mills to be made over. Examination of the bales of stuff arriving at a fiber-board mill shows that a large part of it consists of broken and torn fiber boxes that are coming back to be repulped.

The price of old papers when they reach the mill ranges from $8 to $15 a ton. The average in Chicago, which draws supplies from hundreds of miles on all sides, is about $12 a ton. It is claimed that the cheapest pulp made from wood by present methods can not compete with old papers and other waste in the making of fiber board. If such material should advance in price to about $17 a ton, however, wood pulp at this present price would drive it from the fiber-board mills.

RIVAL CLAIMS OF MERIT.

Though the wooden box has certain fields in which at present the fiber box is not a competitor, nor is there any indication that it will soon become so, the rivalry for trade of the two makes of boxes in most fields is now keen and widespread. In one respect the contest is peculiar, in that each side claims that it is carrying out the principles of conservation by using material which otherwise would be wasted. The specific contention of makers of wooden boxes is that enormous quantities of low-grade lumber are demanded for such boxes, and if not used in that way can not be used at all. From one-fifth to one-sixth of all the sawmill output of the United States is made into boxes. Since the material used is low-grade stuff that remains when the good grades have been culled out, anything that cuts down the sale of wooden boxes leaves that much unsalable lumber on the millman's hands. Lack of statistics has been the cause of misunderstanding. Lumbermen were led to believe that the fiber box had taken 40 per cent of the box trade, and it was believed by many of them that the chief material used in fiber-box manufacture was high-grade wood pulp. That belief has been made the basis of argument against the fiber box, on the ground that its manufacture is inimical to forest conservation. It was pointed out that good timber was being used for pulp, while the low grades were being left to rot at the mills, because the makers of wooden boxes could not buy as much as formerly. The conclusion reached was that, since the wooden box made use of low grades that would otherwise go to waste, while the fiber box drew supplies of high-grade timber available for paper making, the wooden boxes are the means toward the fullest utilization of the products of the forest. The fiber-box manufacturers denied these allegations in whole or in part, and insisted that their

raw material was chiefly such as would be wasted if they did not use it, and they claimed for their industry as complete accord with the principles of conservation as their competitors claimed for theirs.

In the rivalry for trade between the makers of the two kinds of boxes each has been called upon to point out the advantages of his own and the alleged disadvantages of his rival's wares. In connection with the regulation sizes and weights of paper boxes insisted on by the railroads the makers of fiber boxes claim that the contents of fiber containers are as well protected as those in wood, so far as breakage is concerned, and point to a long and varied list of commodities that go to market in fiber boxes. Among these are lamps, globes, dishes, glassware, including jars and bottles, light hardware and tinware, electrical apparatus, dry paints, novelties, toys, clothing, shoes, millinery supplies, books, stationery, and foodstuffs of almost all kinds, and especially crackers, biscuits, dried fruits, cereal foods, and confectionery. A claim put forth by fiber-box makers, and insisted upon as of great importance, is that articles of food shipped in fiber absorb no taste or odor from the box.

The maker of the wooden box maintains that his is the most economical because it may be used again and again, and when beyond further use as a box has still some value as short lumber or kindling wood; the maker of the fiber box answers by pointing to the fact that his product may be repulped and remade as often as it goes back to the mill; the manufacturer of the wooden box insists that his can be more cheaply handled, because it may be grappled with hooks and can resist hard knocks which tear and crush the fiber containers; the maker of the latter admits that it can not be handled with hooks, and that violent falls or bumps may crush it in, but, at the same time, he cites figures from transportation companies and wholesale merchants showing that fiber boxes, because of their lightness and regular size, can be handled at less cost than wooden boxes; he does not admit, however, that a box made of wood can be depended upon to sustain a fall with less injury than a fiber box, and points to accidents where the wooden box has split open and the fiber box remained unopened when both were submitted to similar usage. When boxes are piled high, and the lower tiers by accident become wet, as in case of flood, the fiber containers will, it is claimed, crush and let the upper tiers down, while boxes of wood will continue to sustain the weight, and only the contents of the lower boxes will be damaged. The manufacturers of fiber boxes maintain that fewer thefts occur from their containers in transit and in warerooms than from wooden cases, because they are sealed and can not be opened and closed again without leaving the thief's mark, while a board may be pried from a wooden box and nailed back again, the theft remaining undiscovered until the box reaches

its destination; the wooden-box maker, as an offset to this, asserts that the fiber container suffers as much damage and loss from rats, which easily gnaw into it, as the wooden package suffers from thieves.

EXTENT OF THE WOODEN-BOX INDUSTRY.

Wooden-box manufacturers in 1907 bought 6,500,000,000 feet of lumber, and this figure has generally been taken as a basis for calculating the subsequent falling off in the box trade. In the fall of 1910 the Forest Service completed a study of the wooden-box industry in six States. The study has continued considerably more than a year, and the data collected were not all for exactly the same period, but were approximately contemporaneous. The States were Massachusetts, Maryland, North Carolina, Kentucky, Illinois, and Wisconsin; one New England, one Middle Atlantic, two Southern, one Lake, and one of the Middle West States. These were believed to represent fairly well the average trade and business conditions of the country. A canvass by mail of all the wooden-box makers in these States was supplemented by personal visits to those who failed to furnish satisfactory information. The figures collected as a result of this canvass are believed to be approximately complete and correct. The total quantity of lumber manufactured into boxes in the States named during the year preceding was 1,137,137,000 board feet. This is equivalent to about 63 feet per capita for the States named. If that per capita holds for the whole country, and there is no apparent reason why it should not, the total annual demand for box lumber is about 5,418,000,000 feet; that is, a falling off slightly in excess of 1,000,000,000 feet from the estimate by the box makers in 1907, the year of the large output.

EXTENT OF THE FIBER-BOX INDUSTRY.

To ascertain the status of the fiber-box industry, inquiries, accompanied by reply cards, were sent to 237 manufacturers in the United States who were supposed to be making fiber boxes and containers of various kinds to compete with wooden boxes. It turned out, however, that the majority were not making such commodities. Thirty-seven reported that they made fiber board, but not boxes; 34 that they made boxes, but not board; while a few made both boards and boxes. The making of fiber board and the manufacture of fiber boxes are separate industries, just as the mill that saws lumber and the factory that makes the boxes are distinct. Fiber board is the product of the fiber mill, but the mill does not usually turn out the board in a form suitable for the box maker. Instead the box factory takes the rolls of paper, and with its own machinery glues together a sufficient number of sheets to make a board of the necessary thickness. The board is then cut into the proper patterns, and passing through other machines is made into boxes. What is said in this con-

nection, however, applies solely to fiber boxes of a size and strength which fits them to compete with wood.

The manufacturers of fiber boxes use approximately 116,000 tons of board a year. On the basis of 60-point board this is equivalent to 920,000,000 square feet of surface; on the 80-point basis, it means 748,000,000 feet; and on the 100 point, 579,000,000 feet. If it is assumed that, foot for foot of surface, fiber board and lumber will make the same number of boxes, a basis of comparison is found for the two materials in box making. Of the total quantity of boxes of both kinds made, 85.5 per cent were wood and 14.5 per cent were fiber, if all the fiber were 60-point. If all were 80-point, the percetage would be 87.9 wood and 12.1 fiber; and if the fiber board were 100-point, the percentage would be 90.3 wood, and 9.7 fiber. If the three thicknesses of fiber board were used in equal amounts, the percentage would be 87.9 wood and 12.1 fiber.

The foregoing percentages are based on the use of 6,500,000,000 feet of box lumber, and the assumption that it was all 1 inch thick and was used in that form for boxes. As a matter of fact, however, only large and strong boxes are made of 1-inch lumber; the others are of thinner material, down to a quarter of an inch or less. A thickness of three-quarters of an inch for all wooden boxes would be above rather than below the average. Assuming a three-fourths thickness for the entire quantity of box lumber used in the United States, the 5,418,000,000 board feet would become 7,224,000,000 surface feet. Calculated on that basis, 88.7 per cent of all boxes were wood and 11.3 per cent fiber, if 60-point fiber board was used. If 80-point fiber board was used, the percentages become 90.6 for wood and 9.4 for fiber; while if all fiber board were 100-point the percentages would be 92.3 for wood and 7.7 for fiber. If the three thicknesses of fiber board were used in equal quantities, the general average becomes 90.6 for wooden boxes and 9.4 for fiber.

All fiber board does not compete with wood in box making. Data collected during the investigation show that while 116,000 tons of board were used by box manufacturers, 314,000 tons were purchased for other purposes. Bookbinders demand large quantities for backs of ledgers, blank and check books, tablet backs, and edition work, while printers use much in card and sign printing, and builders for lining and roofing papers. Large quantities are also used by makers of small, light cartons or boxes which do not compete with the wooden box.

THE TWO KINDS OF BOXES COMPARED.

(1) It is impossible to compare the cost of wooden and fiber boxes, except in the most general way, since all fiber boxes do not cost alike, nor do all wooden ones. The average cost of those of fiber, however, is considerably less than those of wood, in most cases 10 per cent or

more. The makers of wooden boxes admit that the cheapness of fiber is the most stubborn factor in the competition, and declare that it has done more than anything else to advance the fiber box to its present place.

(2) Statistics indicate that of the whole quantity of shipping boxes made in the United States, based on the surface measure of the material of which they are made, approximately 90.6 per cent are wooden and 9.4 per cent fiber. A comparison of the amount of lumber reported by the box makers of the entire country as used by them in 1907 and the quantity calculated two years later on the basis of a careful canvass of six States indicates that the wooden box is not quite holding its ground. This conclusion, however, is true only if the six States, Massachusetts, Maryland, North Carolina, Kentucky, Illinois, and Wisconsin, containing about one-fifth of the total population, show the correct average pro rata use of box lumber for the whole country, and if the estimate of box lumber in 1907 is correct.

(3) Competition between wood and fiber for box material is active for rather small boxes and for those for which extra strength is not demanded. Boxes of large size, or for very heavy articles, are of wood, except where reenforced fiber is used.

(4) Fiber board may shed water well for a time, but it can not stand as much as wood, and where boxes are subjected to a penetrating dampness wood is the better material. This is particularly true when the boxes are piled in tiers.

(5) When food products are packed in boxes it is often important that no odor or taste be absorbed from the container. Some woods meet this requirement, while others do not, but fiber boxes are unobjectionable.

(6) Theft from boxes in transit is said to be more frequent for wooden ones than for fiber, but the gnawing by rats in warehouses is much more injurious when the latter boxes are used.

(7) Both wooden and fiber boxes are made largely of waste material, the former of low-grade lumber for which there is small demand elsewhere, and the latter from old papers, straw, rope, and screenings, which otherwise would have small sale. A little excellent wood pulp goes into fiber boxes, and some high-grade lumber is used in making boxes of wood.

(8) The wooden box may be used several times, and at last be converted into kindling wood. Fiber boxes are repulped again and again, to be made each time into new containers, and the advantage of a longer use is clearly on the side of fiber.

(9) The prospect is good that material for both kinds will be adequate to meet the demands for many years. High-grade lumber may run short, but boxes are usually made of the poorer grades, which are now plentiful and promise to remain so. The situation in

Massachusetts is an instructive example of how the demand for box lumber is met in a State whose primeval forests were cut long ago. In that State a total of 351,000,000 feet of box lumber is required yearly, and white pine supplies 263,000,000 feet of it. Practically every tree is second growth, that is, young trees which have grown since the old forests were cut. There is no reason to believe that the annual cut of white pine in Massachusetts will become smaller than it is now, and future supplies will come from woodlots and second-growth forests that are cared for and protected. Thus far the stands of white pine have been the result of natural reproduction; the trees came up on old fields and pastures, and were simply allowed to remain. In most cases no thinning or other cultural operations were performed, and the stands now being utilized for box lumber are frequently less than 50 years old.

Other Eastern States are reaping a similar harvest from the unaided productiveness of their forests. Virginia, where settlement and timber cutting began three centuries ago, has to-day the greatest number of sawmills of any of the States. In spite of the destruction of the original forests, trees kept on coming up. It is due entirely to the strong tendency of the forest to reclothe the land, and not at all to the effort of man, that Virginia to-day has timber for her 3,500 sawmills.

When the States begin to protect their forests and the owners give them aid by planting and proper thinning, forest growth will be vastly accelerated. With the prospect of early attention to these matters in many States, it is altogether probable that supplies of timber suitable for the use of box makers will be ample for years to come.

The makers of fiber boxes are in no more peril of shortage of raw material. The harvest of old papers, jute, screenings, straw, and similar substances promises future abundance. A promising field for the increase of supplies for this industry has not yet been drawn upon. This may be opened by pulping the wood waste at sawmills and in the forest—material that now finds no use of any kind. It is not likely that any mechanical obstacles lie in the way, and practically the only difficulty is the fact that such waste is scattered and the cost of collecting it may be considerable. Thus it may come about that the forest will prove ultimately the source of raw material for the fiber as well as for the wooden box. Beyond this possibility there are enormous quantities of fibers that are available as soon as the demand comes, and the price will justify manufacture. Among these are cornstalks, coarse reeds, grasses, tules, and perhaps cotton stalks and cotton waste.

Approved.

JAMES WILSON,
Secretary of Agriculture.

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